

THE NEW HOLLAND MOUSE *PSEUDOMYS NOVAEHOLLANDIAE* (RODENTIA: MURIDAE), AN ADDITION TO THE MAMMAL FAUNA OF QUEENSLAND

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The New Holland Mouse *Pseudomys novaehollandiae* (Waterhouse, 1843) is reported for the first time from Queensland where an adult male was collected at Crows Nest (near Toowoomba) in open forest. The capture site contrasted markedly with published records of southern *P. novaehollandiae* habitat in its relatively high altitude (560m), distance from the coast (100km), total lack of a dense shrub layer, and advanced seral stage. However, examination of unpublished trapping records from northern New South Wales suggests that at the northern limit of its range these environmental features may not be exceptional. □
Rodentia, Muridae, Pseudomys novaehollandiae, Queensland.

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Thirty years ago the New Holland Mouse *Pseudomys novaehollandiae* (Waterhouse, 1843) was believed extinct or extremely rare in Australia. At that time, given its remarkably obscure status since description in 1843, few would have cared. However, in 1967 it was rediscovered alive at Port Stephens (Keith & Calaby, 1968) and at Ku-ring-gai Chase National Park in New South Wales (Mahoney & Marlow, 1968). Three years later it was recorded from Victoria (Seebeck & Beste, 1970) and then, in 1975, discovered in Tasmania (Hocking, 1980). Since then it has been recorded from widely scattered east-coastal localities between Evans Head (29°07'32"S 153°26'31"E) in New South Wales (Posamentier & Recher, 1974), and Friendly Beaches (42°00'S 148°17'E), Tasmania (Hocking, 1980). In New South Wales its legal status is 'protected', but the species is now the object of considerable conservation concern in Victoria (Wilson, 1993, 1996), where it is regarded as 'endangered' and listed under the Fauna and Flora Guarantee Act 1988.

In New South Wales *P. novaehollandiae* has been recorded in the literature from dry sclerophyll forest associated with a dense shrub layer on dune sands (Keith & Calaby, 1968; Batt et al., 1972), from around the edges of sedge freshwater swamps between dunes (Keith & Calaby, 1968), and from coastal heaths (Posamentier & Recher, 1974; Fox & Fox, 1978). Its occurrence in heath regenerating after sand mining is documented by Fox & Fox (1984). In Victoria it has been trapped in open dry sclerophyll forest (Seebeck & Beste, 1970), woodland and low-open forest with a heathy understorey (Kentish,

1981; Wilson, 1994, 1996), low dense heath (Gilmore, 1977; Braithwaite & Gullan, 1978; Norris et al., 1983; Opie, 1983; Wilson, 1991, 1996), and primary sand dunes with tussocks and sedges or dune scrub with sedges and low shrubs (Quin, 1994; Menkhorst, 1995; Wilson, 1996). Menkhorst (1995) considered optimum Victorian habitat to be seral stages of dry heath. In Tasmania *P. novaehollandiae* has been found in the woodland/heath mosaics of the coastal northeast. The generally accepted importance of early successional vegetation (3-4 years) to this species is discussed by Wilson (1994, 1996).

Relatively recent trapping records from northern New South Wales suggest that the habitat prescription usually associated with *P. novaehollandiae* needs modification. Our report here, of the discovery of the species in Queensland, 100km from the coast and at over 500m elevation, is one of a number of records suggesting this is not atypical for the New Holland Mouse in the north.

THE DISCOVERY

In late August 1996, 12 small Elliott mammal traps baited with bread and jam were set (B.L.) in open forest adjacent to the family home overlooking the township of Crows Nest, 32km north of Toowoomba, southeast Queensland (Fig. 1). The simple trapping exercise was part of field experience for a girls' group staying with the family overnight. Next morning the traps were found to contain 3 House Mice and 2 unfamiliar mice suspected to be Delicate Mice *Pseudomys*

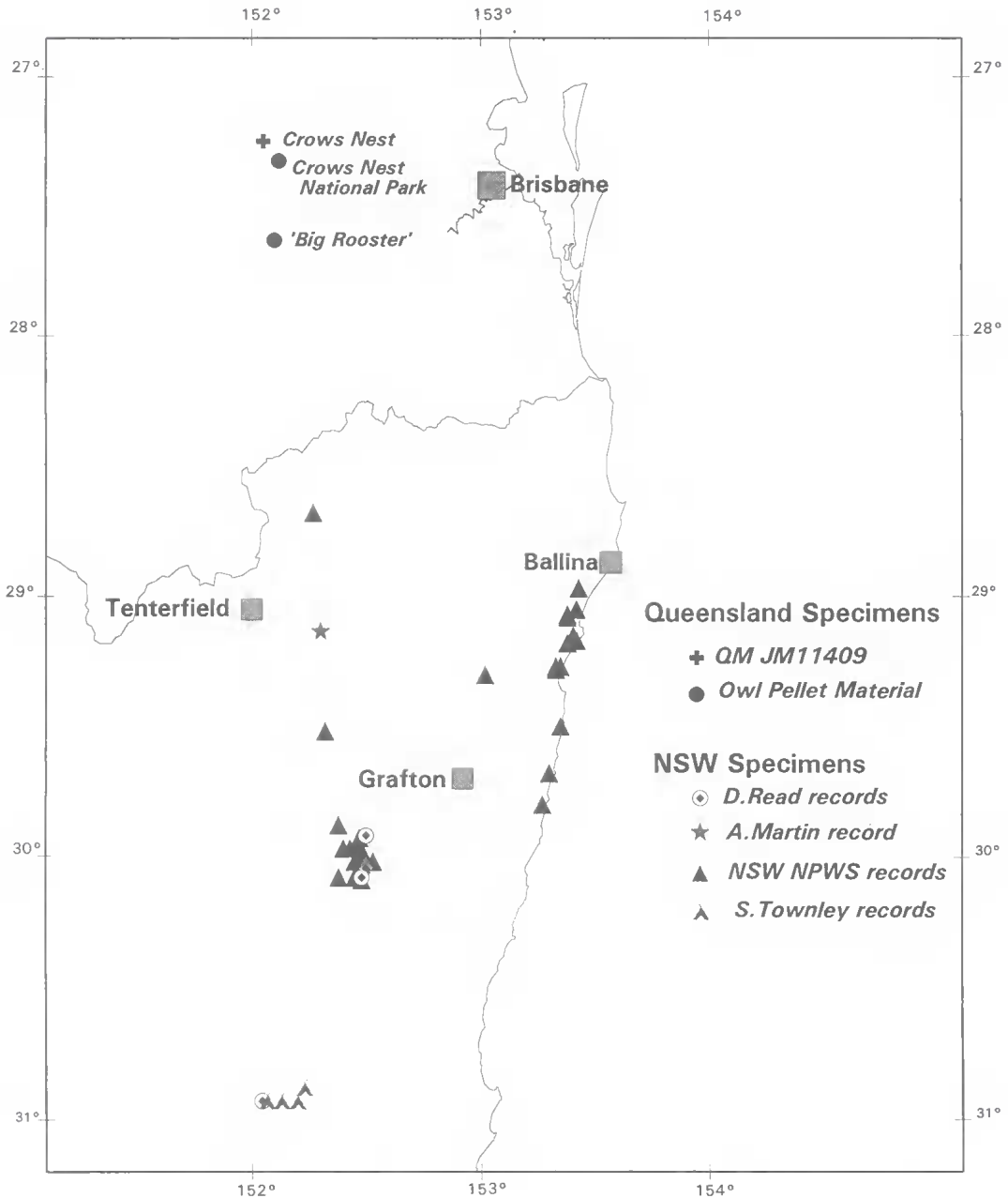


FIG. 1. Collection sites of live *Pseudomys novaehollandiae* and owl pellet material from south-east Queensland, with recent trapping records for northern New South Wales.

delicatulus. One was sent live to the Queensland Museum and the other was released at the capture site. The animal was photographed (Fig. 2) and registered in the Queensland Museum mammal collection as QM JM11409. In assigning an iden-

tity to this specimen, it was compared in particular against type material representing *P. pilligaensis* (see Fox & Briscoe, 1980). The relatively broader rostrum, broader interorbital width, narrower palate and incisive foramen, and relatively

smaller bullae of the Crows Nest specimen collectively suggested its affinities lay with *P. novaehollandiae* and not with *P. pilligaensis*. Analysis of hair samples (B. Triggs pers. comm.) and features of external morphology (B. Wilson pers. comm.) also confirmed the identity of JM11409 as *P. novaehollandiae*.

Since capture of JM11409, trapping (B.L.) at Perseverance section of Crows Nest National Park 453 (150 trap nights), Bungaree section of Crows Nest National Park 453 (150 trap nights), and at, or adjacent to, the original capture site (305 trap nights) has failed to secure more examples of this species.

DESCRIPTION OF CAPTURE SITE

JM11409 (and the released specimen) were caught in tall open forest (27°15'09"S 152°03'22"E), 1km north of Crows Nest. The capture site (Figs 3 & 4) at 560-570m above (mean) sea level (a.s.l.) abuts the town's cemetery.

TOPOGRAPHY AND SOIL. Crows Nest, 100km northwest of Brisbane, is situated on the eastern edge of the Great Dividing Range virtually overlooking Esk in the Brisbane Valley. The Crows Nest Shire's northern boundary is formed by the northeast-southwest-aligned Blackbutt Range which joins the Great Dividing Range at the north-west boundary. Average elevation throughout the Shire is 575m a.s.l., the lowest point in the Shire is Maronghi Creek at around 150m, and the highest, Mt Perseverance at 807m. Topography throughout is mainly undulating; rolling hills to the west and steeply sloping ranges and escarpments to the east. Geology of the area has been mapped by Cranfield & Schwartzbock (1973). Soils throughout are mainly hard-setting loams to clay loams overlying yellowish-grey clay subsoils (solodized solonetz/solodies), deep sands (siliceous sands), reddish-brown clay loams overlying red and brown clays (red-brown earths and yellow earths) and shallow, stony sands and loams (lithosols). Surface soil texture is coarse or clay-loam, and sand is commonly present on the surface. Coarse-grained sediments of the Marburg Formation, Woogaroo Subgroup and Tarong Beds form the parent material. Soils of the general capture area are massive and cross-bedded siliceous sandstone, some conglomerate, minor siltstone and shale. Surface soil in the open forest of the immediate capture area was dark friable clay-loam without sand.

CLIMATE. Annual rainfall in the Shire ranges from 650mm to 1200mm. The collection site receives average annual rainfall of between 750 and 950mm distributed unevenly throughout the year. The dry season months (between April and September) receive average monthly falls of around 50mm whereas the summer months of January and February average around 125mm. Temperature and humidity records are similar to those for Toowoomba (32km south) where daily mean maxima are around 27°C for January/February and 17°C for June/July, with daily mean minima of 17°C for January/February, 6°C for June/July. On average, temperatures exceed 32°C on ten days of the year and frosts occur between May and September. Average humidity is highest February to July (68%) and lowest in September (54%).

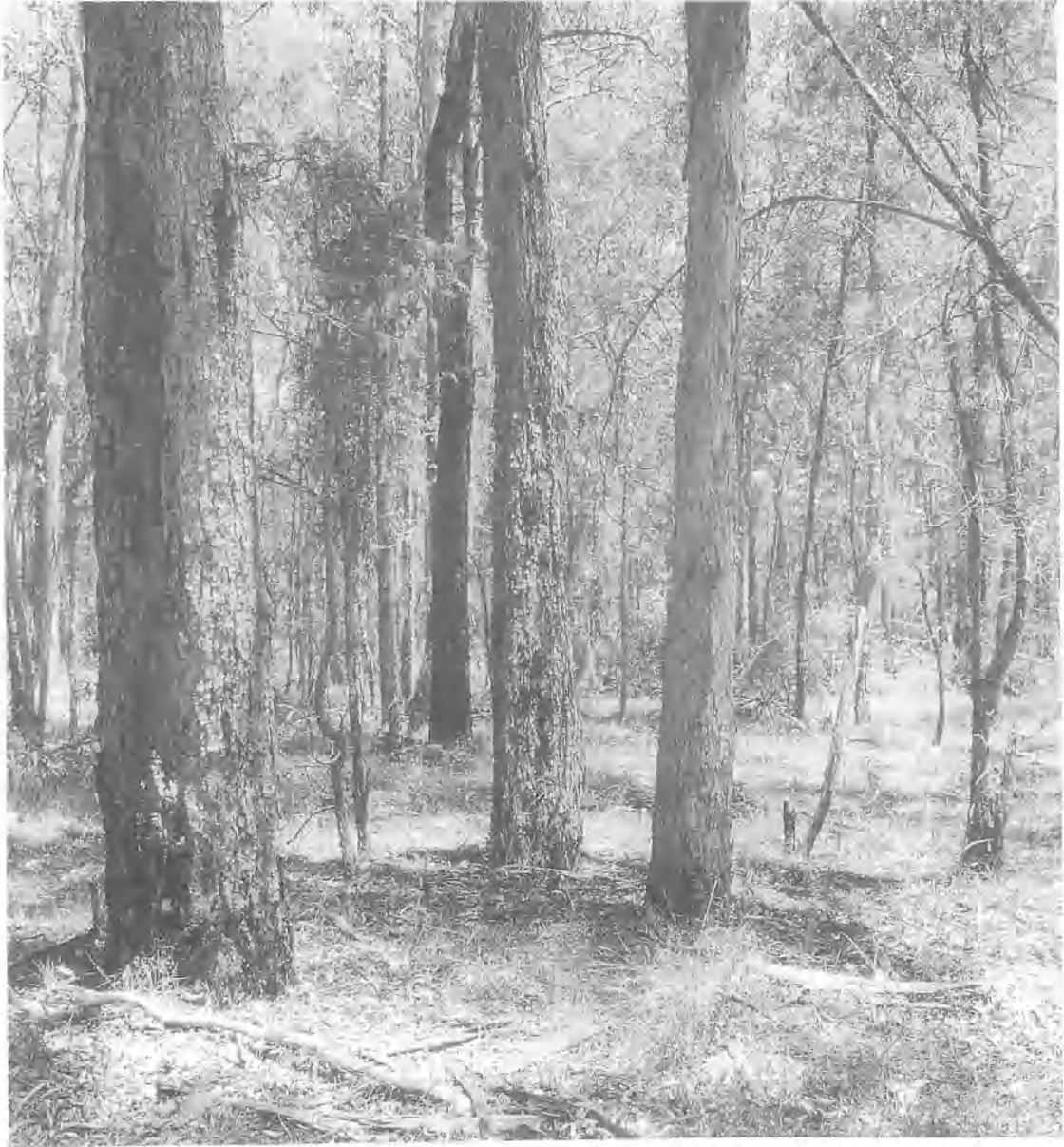
VEGETATION. Vegetation at the capture site was tall open-forest. Dominant species of the upper stratum (18-19m with 60% projected foliage cover) were *Angoptora leiocarpa* (common [C]), brown bloodwood *Corymbia trachyphloia* (C), yellow stringy bark *Eucalyptus acmenoides* (C), Helidon ironbark *E. taurina* (sub-dominant and uncommon [U]) and grey gum *E. major* (C), all to a maximum circumference at breast-height (CBH) of 2m. A very sparse midstorey (6-7m with 8% cover) was composed of eurraebah *Acacia concurrens* (C), lightwood *A. inplexa* (U), Queensland silver wattle *A. podalyriifolia* to 2m (U), rose sheoak *Allocasuarina torulosa* (C), kurrajong *Brachycliton populneus* subsp. *trilobus* to 3m (rare [R]) and *Lophostemon suaveolens* (U). A low, open understorey (75% cover) consisted of the following: *Paspalidium* sp. to 40cm (C), *Patersonia sericea* to 50cm (C), white root *Lobelia purpurascens* (C), *Hardenbergia violacea* (U), *Laxmannia gracilis* to 25cm (R), coffee bush *Breynia oblongifolia* (R), wiry panie *Eutolasia stricta* to 30cm (Abundant [A]), many flowered matrush *Lomandra multiflora* (R), matrush *L. filiformis* to 30cm (A), blue flax lily *Dianella caerulea* (R), tall spear grass *Austrostipa pubescens* in patches up to 5m diameter to 1.5m high, variable sword edge *Lepidosperma laterale* to 60cm (C), blady grass *Lyperata cylindrica* in patches, to 50cm, barbed wire grass *Cymbopogon refractus* to 1m (when seeding) (A), *Solanum nemophilum* to 50cm (A), bower plant *Pandorea jasminoides* (U), monkey rope *Parsonia straminea* climbing to 8m (R), *Acrotriche aggregata* to 2m (A), lady's slipper *Hybanthus monopetalus* to 30cm (U), *Calotis cuneifolius* (R), *C. canifolia* to 20cm (R), *Jack-*



FIG. 2. Adult male *Pseudomys novahollandiae* QMJM11409 from Crows Nest, southeast Queensland.



FIG. 3. Capture site of QMJM11409, Crows Nest, showing low, open understory.



sonia scoparia to 3m (C), *Leucopogon muticus* to 1.5m (U), *Melichrus urceolatus* to 30cm (U), *Goodenia rotundifolia* (A), *Canthium buxifolium* (R), *Maytenus silvestris* to 50cm (C), *Pomax umbellata* to 10cm (C), *Desmodium rhytidophyllum* to 30cm (U), *Grevillea* sp. to 2m (R), and unidentified grasses. It was thickly littered with dead leaves, sticks, fallen trunks and branches.

Approximately 200m east of the collection site, sandstone outcrops and boulders along an ephem-

eral creek became conspicuous and marked a dramatic change in the botanical composition of the understorey and ground layer (Fig. 5). Dominant species of the upper stratum (13m with 50% projected foliage cover) were *Angophora* sp. (A), brown bloodwood *Corymbia trachyphloia* (U) and yellow stringy bark *Eucalyptus acmenoides* (A) to a maximum CBH of 3.35m.

The understorey changed to a dense species-rich heath dominated by *Xanthorrhoea johnsonii*

to 2.3m (A). Around the creek, foliage cover reached 80-90%, in other areas this reduced to 10% with virtual monocultures of *X. johnsonii*. Other heath understorey species included *Leptospermum polygalifolium* to 2.5m (C), *Banksia spinulosa* var. *collina* to 1.2m (C), *Leucopogon muticus* to 2m (U), and *Hakea eriantha* to 1.8m in patches. The shrub layer consisted of *Persoonia sericia* to 80cm (C), *Notelaea linearis* along the heath edge to 2m (C), *Jacksonia scoparia* to 2m (U), *Mirbelia speciosa* subsp. *ringrosei* to 80cm (C), *Hibbertia stricta*, *Stylidium laricifolium* to 60cm in patches, *Melichrus urceolatus* to 40cm (U), *Acrotriche aggregata* to 80cm (U), *Hibbertia linearis* var. *obtusifolium* (U), *Acacia podalyriifolia* along heath edge to 2.1m (U), *Pomax umbellata* 10cm (C), shorthair plume grass *Dichelachne micrantha* to 30cm (C), *Lepidosperma laterale* to 40cm (C), *Austrostipa pubescens* in patches to 1.5m, rock fern *Cheilanthes sieberi* (R), *Entolasia stricta* to 80cm (A), *Paspalidium albillosum* to 80cm (C), *Ozothamnus diosmifolius* (R), *Poranthera microphylla* to 8cm (R), *Pimelea linifolia* to 50cm (U), wiry panic *Entolasia stricta* to 80cm (A), and many unidentified grasses. A thick ground layer consisted of fallen sticks, leaf litter, bark shreds, rocks, logs and an abundance of *Angophora* sp. seed capsules.

Apart from the occasional stray, the collection site is not grazed by cattle, and fire may have been absent from the area for 30 years or more. Unburnt skirts on 2m-high *Xanthorrhoea* individuals were noted almost touching the ground.

THE ANIMAL

Adult male *P. novaehollandiae* JM11409 (Fig. 2) is compared in Table 1 with measurements from a wide range of adult males collected in the Port Stephens area by Keith & Calaby (1968). While the Port Stephens specimens weighed 13-18g (collected in February) and JM11409 weighed slightly less at 12g (collected August) most measurements suggest that, in comparison, the Queensland specimen is a small animal. However, the more commensurate molar measures, and relative lack of molar wear, suggest that the Crows Nest mouse may still have been growing.

DISCUSSION

The suspicion that living *P. novaehollandiae* might occur in Queensland was first aroused in 1993 when Veronica Hinman (University of Queensland) analysed unregistered regurgitated

owl pellet material stored in the Queensland Museum. She attributed fragmentary remains from three southeast Queensland sites to *P. novaehollandiae* (Hinman, 1993). These sites were 1, 'Big Rooster Cave' near Gatton (material excavated by H. Godthelp in June 1982); 2, Perseverance section of Crows Nest National Park (material collected by David Read in May, June 1988); and 3, Cania Gorge (material collected by Mary Wade in 1978). Confirmation of the identity of the Gatton and Cania Gorge fragments was sought from Alex Baynes (Western Australian Museum) who attributed the nine Cania Gorge dentaries to an unknown pebble-mound mouse (now known to be *Pseudomys patrius*, S.V.D. unpublished data). But he was reluctant to assign an identity to the maxillary fragments from the Gatton individual (QM JM10306), its broad, more rounded molars and the unusual relationship between adjacent cusps on M² and M³ being unlike his comparative material of *P. novaehollandiae* from Smith's Lake, New South Wales. Given this finding, the more incomplete Crows Nest National Park fragments (dentaries and maxillary fragments of one individual QM JM10304) were temporarily shelved.

More recent comparison with Victorian specimens (Museum of Victoria C26607, C22127, C10348, C16047) now suggests that the Gatton specimen is, after all, attributable to a large, old individual of *P. novaehollandiae*, and reappraisal of the Crows Nest National Park fragments confirms Hinman's assessment that Read's owl pellets contained a New Holland Mouse. Read's effort of 600 trap nights between 24 May-1 June 1988 in the Crows Nest National Park resulted in no mammal captures (Read, 1988a) but his owl pellet material contained examples of *Rattus lutreolus*, *R. tunneyi*, *P. gracilicaudatus*, *Sminthopsis murina*, *Perameles nasuta*, *Petaurus breviceps* and *Pseudocheirus peregrinus* all of which are registered in the Queensland Museum mammal collection.

'Big Rooster' (south of Gatton) and Crows Nest National Park are approximately 65km S and 5km E, respectively, of the capture site of JM11409. In Crows Nest National Park, Read collected the owl pellets from three caves in the rocky cliffs (around 27°19'S 152°07'E) overlooking Perseverance Creek (Read, 1988a). Godthelp collected the 'Big Rooster' material from a rock shelter in eucalypt forest surrounded by open woodland and degraded grazing country (the exact coordinates of 'Big Rooster' cave have not yet been established but are thought to be



FIG. 5. Heath adjacent to Crows Nest capture site.

around 27°38'S 152°06'E). Trapping (unsuccessful) for living *P. novaehollandiae* has since been conducted in Perseverance section of Crows Nest National Park, but other sites are yet to be surveyed.

Initially, the collection site of IM11409 appeared atypical for *P. novaehollandiae* in its relatively high altitude, distance from the coast, lack of a dense shrub layer, and advanced seral stage. It seemed as far removed from the optimum hab-

itat proposed by Posamentier & Recher (1974) (heath, actively regenerating from fire) as it was from those habitats occupied in Victoria and New South Wales (see Wilson, 1994). However, the distance from Crows Nest to the coast (100km) is actually exceeded by the distance (166km) from the type locality (Yarrandi, near Scone, New South Wales), to the coast. Nearby collection sites at Belltrees (31°59'S 151°08'E, Kemper, 1977) and further east near Barrington Tops (1976 record

TABLE 1. Comparison of Queensland (Crows Nest) specimen QM JM11409 against a Port Stephens (NSW) series of males ($\geq 13g$) (from Keith & Calaby, 1968). Weight expressed in grams, all other measurements in millimetres. For method of measurement see Taylor et al. (1982).

Measurement	QMJM 11409	Port Stephens series		
		No.	Range	Mean
Weight	12	19	13-18	14
Head-body	78.7	19	78-85	84
Tail	76.5	17	86-101	93
Pes	18.7	19	20.5-22	21
Ear	14.4	19	15.5-17	16
Skull length (occipitonasal)	22.8	19	23.1-25.1	24.2
Condylbasal length	20.7	19	21.1-22.5	21.9
Basal length	18.6	19	19.1-20.8	20.0
Zygomatic width	11.5	19	11.5-12.7	11.9
Interorbital width	3.6	19	3.5-4.1	3.8
Interparietal length	2.5	19	2.9-3.8	3.4
Interparietal width	7.2	19	7.3-8.3	7.2
Braincase width	11.0	19	11.1-12.0	11.5
Mastoid width	9.3	19	9.3-10.8	9.9
Nasal length	8.4	19	7.8-9.4	8.6
Nasals width	2.2	19	2.2-2.6	2.4
Palatal length	11.0	19	11.6-12.9	12.3
L. palatal foramen length	4.9	19	4.5-5.4	4.9
Palatal foramina width	1.6	19	1.2-1.8	1.5
Inside M^{1-1} width	2.2	19	2.3-2.7	2.5
Outside M^{1-1} width	1.6	19	4.8-5.3	8.6
Bulla length	5.0	19	4.2-4.9	4.5
Crowns M^{1-3} length	3.4	19	3.5-3.8	3.6
Alveolar M^{1-3} length	3.8	19	3.7-4.0	3.8
Crowns M^{1-2} length	2.9	19	2.5-2.8	2.7

from New South Wales National Parks and Wildlife database) are additional examples of *P. novaehollandiae* habitat situated far from the coast. Although Yarrandi, Belltrees and Barrington Tops are approximately 520km south of Crows Nest, all three collection sites are structurally reminiscent of the Crows Nest site (B. Fox pers. comm.). Furthermore, examination of unpublished reports and relatively recent trapping records suggest that around the northern limits of its range, high altitude and low longitude are regularly encountered features of the *P. novaehollandiae* profile.

Read (1988b) trapped one specimen at 30°05'12"S 152°28'59"E in Marengo State Forest (60km southwest of Grafton, NSW) in 1987, at an altitude of 650m. In August 1992 he trapped a single specimen in the Carai State Forest (inland from Port Macquarie) (Read, 1995), at

30°55'39"S 152°05'19"E and around 860m (D. Read pers. comm.). In September 1993, Sally Townley trapped six individuals on Carai Plateau, at 30°52'59"S 152°14'14"E, and an altitude of 900m. Here, the site was open forest of mainly *E. laevopinea* with an understorey dominated by *Lomandra* sp. (S. Townley pers. comm.). Both Read and Townley have trapped *P. novaehollandiae* in Chaelundi State Forest. In March 1991 Read caught an individual at 29°55'S 152°30'E on grass-covered alluvium with an *E. tereticornis* overstorey (Read, 1993). In October 1993, Townley caught several animals at 30°01'21"S 152°29'46"E at an altitude of 840m. The forest type was New England blackbutt *E. campanulata*, grey gum *E. propinqua*, yellow stringy bark *E. acmenoides*, blue gum *E. saligna* and tallow-wood *E. microcorys* with an understorey of shrubs, grasses and small herbs (Townley, 1993). More recently, over 20 individuals of *P. novaehollandiae* were trapped by Townley at a number of sites in Oxley Wild Rivers National Park (southeast of Armidale) around 30°55-56'S 152°04-12'E, along an altitudinal gradient from about 400-1000m. Trapping sites supported various types of open forest with overstorey trees including New England blackbutt, grey box, Blakely's red gum *E. blakelyi*, blue gum and grey gum. Some sites had grassy understoreys and others had a dense heath layer (S. Townley, pers. comm.).

Closer to the Queensland border, one specimen has been trapped at around 900m a.s.l. on Timbarra Plateau, 29°07'38"S 152°18'22"E, east of Tenterfield, in forest dominated by New England blackbutt and *E. olida*, with a heathy understorey (Martin, 1995). New South Wales National Parks and Wildlife database records document a 1987 record of *P. novaehollandiae* as far north as 28°41'S 152°16'E (southeast of Lindsay View) at around 828m. This, and other most northerly records from that database appear with the Read, Townley and Queensland records in Fig. 1.

All these records confirm both the regular occurrence of *P. novaehollandiae* at high altitudes, and the use of tall open-forest at low latitudes. Some of the records confirm its presence in grassy understoreys. However, the proximity of grassy understorey to heath (or other forms of dense understorey) should be examined before attributing grass as a preferred habitat to the species. For example, the Crows Nest capture site was 182m away from an adjacent area of species-rich, densely shrubbed (but dry) heath. While

Kemper (1977) reported an order of habitat preference in *P. novaehollandiae* from heath to open forest regenerating after recent burning. Fox & McKay (1981) showed that the habitat requirements of the species were most likely contained completely within the shrub layer of heath-type species with the presence or absence of trees unimportant. More recently Fox (1996), re-confirmed *P. novaehollandiae* as a species selecting bare ground and vegetation open to a height of 20cm (typical of the early seral stages). But, he showed that although in open forest its maximum abundance occurs around 1.5 years after burning (followed by decreased abundance), it re-peaked in abundance around 16 years after the initial burn, by which time the understorey was open to around 2m above the ground. In heath, similar peaks occurred at 3 and 13 years following fire.

Male JM11409 (weighing 12g at capture in August) may have been relatively young at the time of capture. Kemper (1980) recorded sexually mature and immature males from mid-coastal New South Wales at mean weights of 14.3g and 12.9g respectively. One third of males in her study achieved sexual maturity in the breeding season of their birth (August to January, and occasionally to March). That the Crows Nest male JM11409 was still growing, is made more plausible by the recent extension of the *P. novaehollandiae* breeding season (in New South Wales) to late July (Fox, Higgs & Luo, 1993). Although trapped in an open grassy understorey, male JM11409, if still relatively young, might not have been residing in the area, but dispersing through it.

The contemporaneous coastal occurrence of the New Holland Mouse at low latitude near Evans Head (29°07'32"S 153°26'31"E) demonstrates that in the north, habitat parameters are much broader than those previously ascribed to the species. Indeed, there seems little reason to doubt that it should also occur in coastal Queensland. Habitat resembling that utilised by *P. novaehollandiae* in Victoria and New South Wales would appear to occur in coastal and offshore southeastern Queensland heaths and sanded dunes, particularly in localities such as Coolangatta, North and South Stradbroke Islands, Moreton Is and the Great Sandy Region.

Ironically, the following comment made by Keith and Calaby soon after *P. novaehollandiae* was rediscovered alive in New South Wales has not yet outlived its pertinence 30 years on: 'This discovery of a populous colony of the New Holland mouse in an area close to urban settlement

and industrial development is an indication of our lack of knowledge of the abundance and distribution of at least some members of the indigenous fauna' (Keith & Calaby, 1968: 58).

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